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THE SYSTEMATIC STATUS OF THE SUCKERS OF
THE GENUS *MOXOSTOMA* FROM TEXAS,
NEW MEXICO AND MEXICO

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The occurrence on the Pacific slope of Mexico of *Moxostoma*, a genus of suckers widespread in eastern and central United States, was first noted by Bean (1880). Regan (1907) treated more fully the southwestern representatives of this genus and presented a key to the identification of the nominal forms. Aside from scattered distributional records, the Mexican forms have not been reviewed since that time. DeBuen (1940: 11) and Alvarez (1950: 42-43) relied entirely on Regan's paper in their treatment of *Moxostoma*.

The lack of attention to the Mexican forms is not surprising in view of the confusion that has attended studies of the more northern and better sampled species. Three subgenera, *Moxostoma* Rafinesque, *Megapharynx* Legendre, and *Scartomyzon* Fowler were recognized by Robins and Raney (1956) who noted that the nominal Mexican species clearly belong to *Scartomyzon*. Very little material of nominal Texan and Mexican forms was at hand when we treated this subgenus and only brief mention was made of them. The close relationship of *congestum* and *austinum* with the geographically distant *robustum* was noted. This tentative assignment has been verified in the current study.

Through the efforts of Robert R. Miller and John T. Greenbank, considerable material is now available from Mexico and more extended comment is possible. We are especially indebted to Dr. Miller who has freely made available his extended knowledge of the relations of the river systems and their faunas. We also acknowledge the assistance of Reeve M. Bailey, Museum of Zoology, University of Michigan, for the loan of specimens under his care. Leonard P. Schultz, Ernest A. Lachner, and Robert H. Kanazawa of the United States National Museum have been helpful in many ways including making available working space, literature, and specimens, and in arranging shipments of material. George S. Myers and Margaret H. Storey have similarly aided us at the Stanford Natural History Museum.

A gazetteer of localities and a map of Mexico is given by Meek (1904: xxviii-xxx and opposite page xlvi). The National Geographic Society's map of Mexico and Central America (edition of March,

¹ Contribution No. 191 The Marine Laboratory.

² Supported by National Science Foundation Grant No. 2893.

1953) shows the river systems and many of the localities mentioned below. Counts and measurements were taken as explained in Robins and Raney (1956: 4). Abbreviations used are: CU = Cornell University, SNHM = Stanford Natural History Museum, UMMZ = University of Michigan Museum of Zoology, USNM = United States National Museum.

Six nominal forms are considered here: *Ptychostomus congestus* Baird and Girard (1854), *Ptychostomus albidus* Girard (1856), *Moxostoma austrina* Bean (1880), *Moxostoma mascotae* Regan (1907), and *Moxostoma parvidens* Regan (1907). Of these only *austrina* and *mascotae* apply to populations on the Pacific slope. An examination of all extant material has shown that three species are included.

The following key summarizes our concept of the species involved.

KEY TO THE SPECIES AND SUBSPECIES OF *Moxostoma* (*Scartomyzon*)
FROM TEXAS, NEW MEXICO AND MEXICO
(based on adults and large juveniles)

1. Pectoral fin short; its length is much less than depth of head at occiput and enters standard length 5.5 or more times in adults. Intestine coiled in rather open loops, no tight spiral on the right side. Depth of head at occiput greater than its width (*Moxostoma austrinum*) 4
- Pectoral fin long; its length is greater than depth of head at occiput and enters standard length 5 or fewer times. Intestine coiled in a tight spiral situated ventrally on the right side. Depth of head at occiput equal to the head width (*M. congestum*) or greater (*M. mascotae*) 2
2. Lacks keel on dorsum. Head subconical in lateral view; U-shaped in dorsal view. Mouth moderate in size and slightly oblique. Upper lip is overhung by the conical snout. Infraorbital canal lacks lateral canals and has numerous large pores. Occipital line curved and anteriorly does not reach the vertical extension of the posterior border of cheek. Pharyngeal shelf is wider than height of largest tooth. Body stout. (*Moxostoma congestum*) 3
- Hard bony keel present under skin on mid-dorsum between occiput and origin of dorsal fin. Head subquadrate in lateral view; V-shaped in dorsal view except for truncate tip. Mouth large, horizontal, and located far forward. The upper lip extends as far anteriorly as the snout tip. Infraorbital canal with few but well

developed lateral canals which terminate in small pores. Midsection of occipital line truncate; reaches anteriorly to the posterior border of cheek. Pharyngeal shelf narrower than height of largest tooth. Body elongate and compressed. ——— *Moxostoma mascotae* Regan

3. Dorsal rays usually 12. The hind margin of lower lip curved, the two halves meet at an obtuse angle. Lower lips restricted laterally and circumscribed by folds of skin. Canal and pores of lateral line often inconspicuous and reduced or absent in many juveniles.

————— *Moxostoma congestum congestum* (Baird and Girard)

Dorsal rays usually 11. Lower lip full, its hind margin quite straight and its outer corners often squarish. Lower lips lack surrounding folds of skin. Lateral-line canal well developed even in young. ——— *Moxostoma congestum albidum* (Girard)

4. Dorsal ray usually 11. Plicae of lower lip number fewer (approximately 20) and are entire. Pectoral and anal fins rounded. Distance from hypural to pelvic base when measured forward reaches the upper lip.

————— *Moxostoma austrinum austrinum* (Bean)

Dorsal rays usually 12. Plicae of the lower lip are greater in number (approximately 25) and the posterior half of some tend to break up and are semipapillose. Pectoral and anal fins pointed. Distance from mid base of hypural to pelvic base when measured forward reaches to (rarely) or behind the lower lip. *Moxostoma austrinum milleri*, new subsp.

MOXOSTOMA CONGESTUM (BAIRD AND GIRARD)

Description.—A moderate sized species; the largest specimen examined was 274 mm in standard length. The dorsal profile is strongly convex from the origin of the dorsal fin, the highest point on the body, to the tip of the snout. Posterior to this point the dorsal contour is gently concave; the steepest portion of the slope is along the base of the dorsal fin. The ventral contour is flat anterior to the anus and along the caudal peduncle whereas the body deepens distinctly from the posterior base of the anal fin to the anus.

The body is variable in width. Specimens from the Llano River are especially robust; their greatest width nearly equals the greatest depth. In most specimens, however, the body is more compressed, much less wide than deep, a feature which emphasizes the considerable depth of body.

In lateral view the head is subconical. The head depth at the occiput slightly exceeds the head width. Viewed from above the snout is U-shaped whereas, laterally, its profile forms a smooth curve with the predorsal profile. The eye is somewhat forward of the midpoint of the head. The mouth is included; it is moderate in size and the gape forms a broad arc. Differences exist between the subspecies *albidum* and *congestum* in the detailed configuration of the lips although both are basically plicate. They will be described later.

The occipital line at its most forward point generally does not reach the vertical extension from posterior margin of the cheek.

The origin of the dorsal fin is slightly in advance of the midpoint of the body, and lies directly over the tip of the depressed pectoral fin. The pelvic insertion is under the anterior half of the dorsal fin.

Berner (1948: 140-141) noted differences between the genera *Ictiobus* and *Carpiodes* in the shape and number of intestinal convolutions. The amount of inter- and intra-specific variation in this feature and its reliability in general as a systematic tool has been little studied and should be investigated. In *congestum* a large spiral of intestine is situated ventrally on the right side. This is similar to the condition found in *mascoetae* but quite different from the open looping seen in *austrinum* which resembles Berner's (*loc. cit.*, figs. 1-2) illustration of *Ictiobus*. Interestingly, *robustum* exhibits a somewhat intermediate condition between *congestum* and *austrinum* in this feature. The peritoneum is silvery.

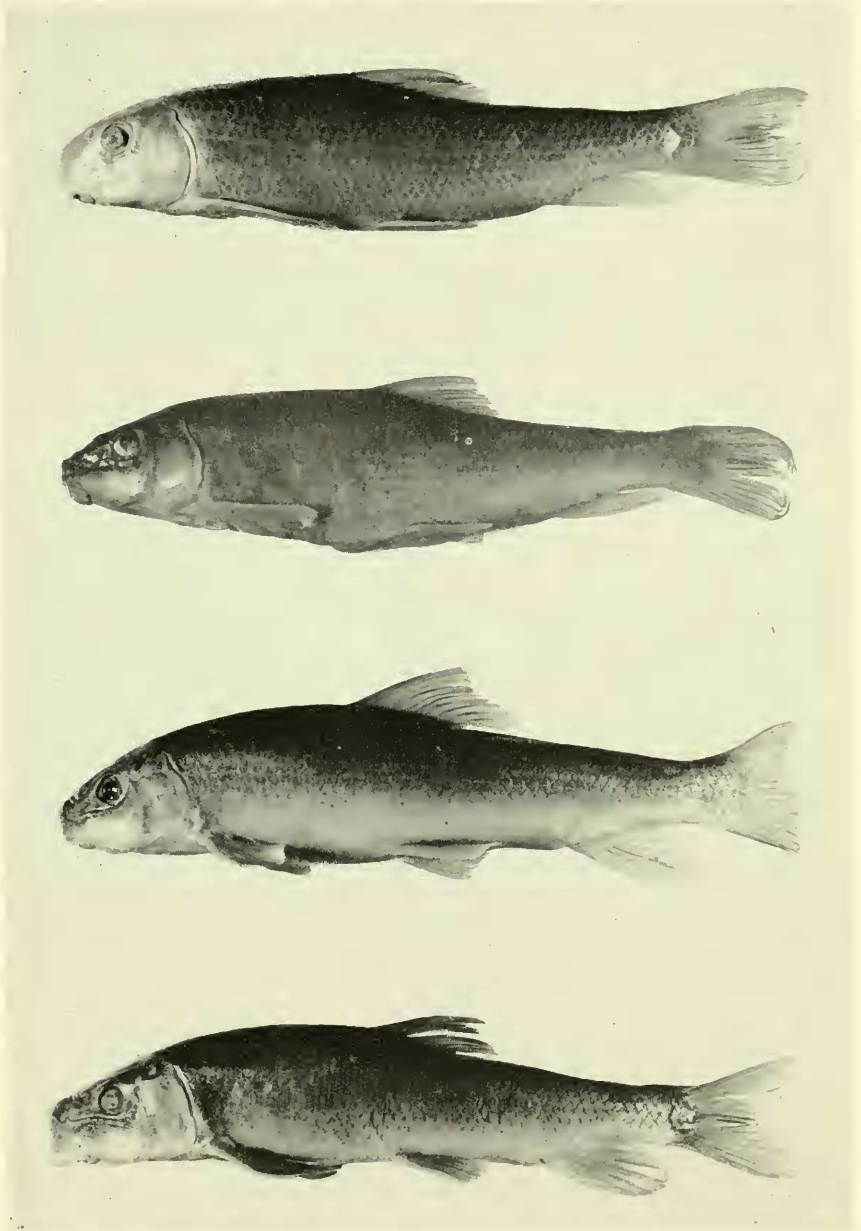
The pharyngeal arch is scythe-shaped. The third or fourth tooth is largest; the other teeth gradually diminish in size toward the tip of the arch. The teeth are compressed, numerous, and somewhat hooked at the tip. The lateral shelf is broad; the distance from the base of the tooth row to the margin of the shelf at its widest point is greater than the height of the teeth. The fontanelle is rectangular.

The features of the tripus are noted under relationships and comparisons. In this character *congestum* is closest to *robustum* whereas *mascoetae* and *austrinum* are similar. Fin-ray and lateral-line scale counts, and proportional measurements are given in tables 1 and 2.

Coloration.—The body is not sharply bicolored; alternate dark and light colored streaks extend to the venter. The under parts of the head, body, pectoral and pelvic fins are light colored.

The lateral scales are outlined in dark but the conspicuously paler central region of each scale appears to join the next to form the light longitudinal streaks on the body. The contrast between center and edge of scale is less obvious on the dorsum. The head is bicolored; the lower half of the cheek and snout is light. Melanophores are scattered on the upper half of the inner surface of the opercle. The occipital line is not much darker than the nape and is inconspicuous; nor is the continuation of this line very evident on the shoulder.

The pectoral fins are not heavily pigmented on their dorsal surfaces.



Figures 1-4. 1. (top) *Moxostoma congestum albidum*, adult female, 194 mm in standard length, from Rio San Juan near Monterey, Nuevo Leon, Mexico (Rio Grande Drainage), UMMZ 97382; 2. (second) *Moxostoma austrinum milleri*, holotype, female, 138 mm from the Rio Mezquital at Rayar, about 5 miles south of Durango City, Durango, Mexico, USNM 132446; 3. (third) *Moxostoma austrinum austrinum*, adult male, 171 mm, from a tributary of Rio San Pedro at bridge 9 miles northeast of Autlán, Jalisco, Mexico (Rio Armeria Drainage), UMMZ 172206; 4. (bottom) *Moxostoma mascotae*, adult male, 188.5 mm, from Rio Ameca, 25 miles east (by highway 70) of Ameca, Jalisco, Mexico. UMMZ 172125. (All photographs by Douglass M. Payne)

However, the first ray is pale, and the darker coloration extends from the second ray where it is most intense over the remainder of the fin, a common pattern in the subgenus. The surfaces of the pelvic fin are light except for scattered melanophores on the upper side of the second to third rays in occasional specimens.

The dark interradial membranes are a conspicuous feature of the dorsal fin and mid-caudal region. This feature is shared by the related species; *robustum*, *mascotae* and *austrinum*. The interradial membranes of the anal fin are often similarly pigmented although this is not evident in young and juvenile specimens.

Sexual dimorphism.—The edge of the dorsal fin in males is sigmoidal, due to the expansion of the hind portion of the fin. In females the posterior edge of the dorsal fin is straight.

The pelvic fins do not show sexual dimorphism to the extent noted by us in other *Scartomyzon* including *austrinum* and *mascotae*. The outer pelvic rays in our specimens of *congestum* are generally longer in both sexes. The anal fin is slightly longer in the male but the fin is not more expanded than in the female. No nuptial tubercles are present. Apparently none of the specimens examined were taken in the breeding season.

Distribution and ecology.—*M. congestum* is distributed from the Rio Soto la Marina of Tamaulipas in northeastern Mexico and the Rio Conchos of Chihuahau (drainage of the Rio Grande) northward to the valley of the Brazos River in Texas. It extends westward to the Rio Florido of Durango, in the Rio Grande proper at least to El Paso and in the Pecos River to the vicinity of the Roswell, New Mexico. Hubbs, Kuehne and Ball (1953: 225) note that *M. c. congestum* is found (in the Guadalupe River of Texas) most abundantly in pools with silt bottom and that young are often found in moving water. Woolman (1894: 56) records the species as abundant in a rocky area in the Rio Grande near El Paso. Bonham (1941: 360-361) reported specimens up to 9 inches long from the stomachs of the longnose gar, *Lepisosteus osseus*, in the Guadalupe River in Kerr County, Texas. This seems to indicate that even fairly small individuals will enter quiet-water situations. Lachner collected specimens in the Brazos Drainage from pools below a dam. The vegetation here was abundant and the water was white and clear.

Relationships and comparisons.—There is no doubt about the close relation of the four species, *robustum*, *congestum*, *austrinum* and *mascotae*. However, within this species group, the similarity of *mascotae* and *congestum* in possessing a long pectoral fin (see key above) is clearly due to convergence. The differences between *robustum* and *congestum* were treated in Robins and Raney (1956). *M. robustum* lines up closely with *congestum* and differs from *austrinum* and *mascotae* in the characters considered below. It was noted by Robins and Raney (1956) that the tripus of *austrinum* differed from that of *congestum* in having the medial edge of the anterior shelf projecting

dorsally; the tripus of *mascoctae* is similar to that of *austrinum*. This feature is best seen from the medial aspects. We believe that this character is indicative of the natural relationships. Other characters strengthen this view although convergence in some, such as the length of the pectoral rays, make them less useful.

Other characters that separate *congestum* from *austrinum* and *mascoctae* are as follows. *M. congestum* is a stouter fish. Viewed from above the head is primarily V-shaped in *austrinum* and *mascoctae* whereas it is broadly U-shaped in *congestum*. The head is broader throughout in *congestum*. The depth of the head at the occiput is about equal to the head width while in *austrinum* and *mascoctae* it is deeper than wide due in part to the fact that the nape extends further forward in *austrinum*. This gives a different appearance to the temporal region where the middle third of the occipital line is truncate in *austrinum* and *mascoctae* but in *congestum* it is evenly curved. The lips and gape are wide in *congestum* but elongate in *austrinum* and *mascoctae*. In *mascoctae* the mouth is especially large. One of the best differences lies in the nature of the lateral tubes and cephalic pores of the infraorbital canal in adults. In *austrinum* and *mascoctae* the pores are small and are located at the end of small but well developed side canals whereas in *congestum* the lateral canals are wanting or poorly developed and the large pores are on the infraorbital canal proper. In *congestum* the preopercular mandibular canal is usually not connected to the suborbital branch. In *austrinum* and *mascoctae* the connection may or may not be present. Considerable individual variation exists in the pathways of the cephalic canals on the top of the head in all forms.

The pectoral fin is long in *congestum*; its length considerably exceeds the distance from the snout tip to the occipital line and enters the standard length less than five times. It is shorter in *austrinum* but *mascoctae* converges with *congestum* in this character.

SUBSPECIES OF MOXOSTOMA CONGESTUM

Our material of *congestum* is separable into two allopatric units. While there is little evidence of intergradation we feel that these two units are best considered as subspecies. *M. c. congestum* and *M. c. albidum* are north-south representatives which differ most trenchantly in the numbers of dorsal rays and in the configuration of the lips.

MOXOSTOMA CONGESTUM CONGESTUM (BAIRD AND GIRARD)

Catostomus congestus.—Baird and Girard, 1854: 27 (description; type locality: Rio Salado, Texas). Gunther, 1868: 19 (compiled). Jordan and Gilbert, 1883: 138 (erroneously associated, fide Cope, with *M. macrolepidotum*).

Ptychostomus congestus.—Girard, 1856: 172 (compiled). Girard, 1859: 36, pl. 21, figs. 5-8 (description given in detail for first time).

Teretulus congestus.—Jordan and Copeland, 1876: 157 (name only).

Myxostoma congesta.—Jordan, 1878a: 317 (compiled). Jordan,

1884: 317 (in part, compiled; *M. bucco* wrongly identified with *congestum*).

Myxostoma congestum.—Jordan, 1878c: 118, 133 (compiled: *Ptychostomus bucco* Cope erroneously assigned to synonymy of *congestum*).

Myxostoma macrolepidotum.—Cope, 1880: 36 (misidentification; Guadalupe River, Texas).

Moxostoma congestum.—Jordan, 1885a: 119-120 (compiled; wrongly includes *albidum*). 1885b: 19-20 (description based on material from the Rio Lampasas—see below under material examined—specimens from Ash Creek, Arizona¹ misidentified as *congestum*). Jordan and Gilbert, 1886 (recorded from Rio Lampasas, p. 17; Rio Colorado at Austin, p. 20; Rio San Marcos, p. 22; Rio Comal, p. 23; *albidum* wrongly included in synonymy). Evermann and Kendall, 1894: 98, pl. 16 (literature reviewed; Rio Salado, Guadalupe and Llano rivers, Rio Lampasas, Rio San Marcos records only; new material from San Antonio Springs). Woolman, 1895: 56 (Rio Grande at El Paso del Norte). Jordan and Evermann, 1896a: 242 (compiled). 1896b: 192 (*Catostomus texanus* Abbott = *Xyrauchen texanus* and *M. albidum* wrongly placed in synonymy; specimens from Ash Cr., Ariz. again misidentified as *congestum*). 1900: pl. 36 (illustration only). Regan, 1907: 146 (in part: Rio Lampasas and Rio Salado in Texas; description and other records apply to *albidum*). Fowler, 1904: 243-244 (description of specimen from Del Rio, Texas). 1913: 57 (compiled). Jordan, Evermann and Clark, 1930: 110 (compiled; *albidum* and *congestum* combined). Schrenkeisen, 1938: 93 (compiled). Bonham, 1941: 360-361 (recorded from Guadalupe River, on basis of stomach analysis of gar). Fowler, 1945: 23 (compiled: Colorado R. and Rio Grande, Texas, also the Brazos R. and the Rio San Antonio, Texas). Baughman, 1950: 129 (name only). Alvarez, 1950: 42-43 compiled; Mexican records referable to *albidum*). Jurgens and Hubbs, 1953: 13 (name only). Hubbs, 1954: 278 (range, type of *Catostomus texanus* Abbott wrongly identified with *congestum*).

Myzostoma congestum.—Meek, 1904: xxxi, 34 (El Paso record only).

Moxostoma duquesnii.—Fowler, 1945: 24 (misidentification, records from the Colorado and Guadalupe (sic) rivers, Texas.) Hubbs, 1954: 278 (record from Fowler correctly presumed to be based on material of *congestum*).

Moxostoma congestum albidum.—Baughman, 1950: 129 (name only).

Moxostoma congestum congestum.—Knapp, 1953: 45, 48, fig. 49 (range, compiled). Hubbs, Kuehne and Ball, 1953: 225, fig. 6 (distribution in upper Guadalupe R.).

Material examined.—Two cotypes, USNM 171, are present in the United States National Museum. They were taken in 1851 from the Rio Salado, Texas by John H. Clark. The largest specimen, 117 mm in standard length, was illustrated by Girard (1859: pl. 21, fig. 5) and is here designated as lectotype. It retains the catalog number USNM 171. The smaller "cotype", 91 mm in standard length, is recataloged under USNM 164525. Girard's life-size drawing (loc. cit.) is a good likeness of the lectotype except that it appears to show 11 dorsal rays (the lectotype has 12) and does not show the typical streaking of the body (see Robins and Raney, 1956, pl. 3).

¹ The "Ash Creek" specimens have been identified with *M. aureolum* (LeSeuer) by Robins and Raney (1957) and the locality is considered erroneous.

Brazos River System.—USNM 36562 (6, 64-292), USNM 36561 (2, 145-171), USNM 36563 (3, 144-164), USNM 36510 (1, 305), SNHM 1300 (1, 153) all from the Lampasas River (Rio Lampasas) at Belton, Texas, collected in 1884 by Jordan and Gilbert. (USNM 36510 is the specimen illustrated by Evermann and Kendall, 1894, pl. 16.) USNM 166144 (7, 89-104), trib. of the Brazos R., at Salada, on U. S. Highway 81, Bell Co., Texas, April 14, 1952, E. A. Lachner, W. T. Leapley and F. J. Schwartz. UMMZ 120191 (7, 110-175), South Bosgue R., McLennan Co., Texas, June 21, 1938, C. L. Hubbs and family and L. T. Murray.

Colorado River System.—USNM 35607 (1, 190), USNM 36567 (3, 89-206), USNM 36508 (1, 206), SNHM 5871 (1, 161) all from the Rio Colorado at Austin, Texas, collected in 1884 by Jordan and Gilbert. CU 26585 (4, 161-274) Mt. Holy Lake, Johnson Fk. of Llano R. at Mt. Home, Kimble Co., Texas, March 12, 1939, A. H. Cook.

Guadalupe River System.—USNM 36538 (1, 146), Rio Comal, New Braunfels (Comal Co.), Texas, 1884, Jordan and Gilbert. USNM 58794 (1, 153), Blanco R., Texas (about 1907), Bur. Fisheries. USNM 166187 (2, 28-29) Guadalupe R., 10 mi. S. of Gonzales, Gonzales Co., May 26, 1952, Kuehne and Ball. USNM 36521 (1, 84) Rio San Marcos at San Marcos (Hays Co.), Texas, 1884, Jordan and Gilbert.

Nueces River System.—USNM 108974 (2, 107-108), Sabinal R., near Sabinal, Uvalde Co., Texas, August 8, 1934, C. E. Burt expedition.

Rio Grande System.—UMMZ 120295 (4, 127-202) Pinto Cr., Kinney Co., Texas, June 25, 1938, C. L. Hubbs and family. USNM 3395 (2, 185-187), Pecos R., coll. by Capt. Pope. UMMZ 66181 (2, 89-104) New Mexico, S. of Roswell, April 3, 1916. USNM 44627 (2, 281-324), USNM 44628 (2, 150-174) Mexican Boundary, Ft. Clark (Kinney Co.), Texas, 1893, Dr. E. A. Mearns. SNHM 844 (1, 61) Rio Grande at El Paso, Texas, A. J. Woolman.

Description.—Dorsal rays usually number 12, rarely 11. The lateral line is variously developed. In most juveniles and in many adults it is absent or obsolescent. In some the pores may be seen but the canal, so conspicuous in all other species of *Moxostoma* and in *albidum*, is little developed. This lack of development is best seen in specimens from the Brazos Drainage although it is noted in specimens from the Rio San Marcos, Rio Colorado and to a lesser degree elsewhere. Specimens from the Llano River and most large adults have a well developed lateral line.

The mouth is rather small although the lips may be much expanded in large adults. The lower lip has an emarginate posterior border; the two halves usually meeting at an obtuse angle. The posterior lateral borders of the lower lip are reduced and circumscribed by fleshy folds. In extremes, (specimens from the Brazos River this infolding of the lower lip will cause the two halves to meet at an acute angle.

The body is conspicuously streaked. Again this feature is extreme in juveniles and is best marked in a series from the Brazos Drainage (USNM 166144).

Young individuals of *M. robustum* are also conspicuously streaked in contrast to the unstreaked juveniles of *mascoetae* and *austrinum*.

In the reduction in lips, the streaked body and reduction in lateral

line, juvenile specimens of *congestum* resemble the spotted sucker, *Minytrema melanops*. Despite its *Minytrema*-like appearance this form differs in the fundamental characters which separate the tribes Moxostomatini and Erimyzonini (see Nelson, 1948 and 1949) including the three-chambered air bladder.

Another fundamental and easily observed difference noted by us is the presence in *Minytrema* and *Erimyzon* of a wide suborbital shelf which is formed by the bones of the circumorbital series. In all *Moxostoma* the circumorbitals are a narrow tube-like series of bones. Gunther (1868: 18-22) apparently also noted this broad shelf in nominal forms which we today assign to the tribe Erimyzonini. Fin-ray counts and proportional measurements are shown in tables 1 and 2.

Range.—Widely distributed in Texas, in tributaries of the Gulf of Mexico, from the Brazos River (as far north as Palo Pinto County) south and east in Colorado, Guadalupe and Nueces Rivers, the Rio San Antonio and the Rio Grande and its northern tributaries (Pinto Cr., the Devil's and Pecos rivers) and from the Rio Grande itself at El Paso. It occurs in New Mexico in the Pecos River (Roswell) and probably also ranges northward in the Rio Grande proper.

MOXOSTOMA CONGESTUM ALBIDUM (GIRARD)

Ptychostomus albidus.—Girard, 1856: 152 (description; type locality: Rio San Juan, Monterey, Nuevo Leon, Mexico). 1859: 36-37, pl. 19, figs. 5-8 (detailed description presented for first time).

Teretulus albidus.—Jordan and Copeland, 1876: 157 (name only).

Myxostoma albidum.—Jordan, 1878a: 315 (compiled); 1878b: 417 (compiled); 1878c: 117, 129 (compiled, scales erroneously listed as 56).

Myxostoma albidum.—Jordan and Gilbert, 1883: 141-142 (compiled).

Myxostoma albida.—Jordan, 1884: 315 (in part, compiled).

Myxostoma congestum.—Jordan, 1885a: 120 (type of *albidum* considered to be young of *congestum*); 1885b: 19 (do.). Evermann and Kendall, 1884: 98 (combined with *congestum*; record from Rio San Juan, only referable to *albidum*). Jordan and Evermann, 1896b: 192 (in part, compiled). Meek, 1902: 76 (specimens from the Rio Noavaca at Santa Rosalia in the Conchos system, Chihuahua). Regan, 1907: 146 (description and records exclusive of R. Lampasas and R. Salado in Texas). Jordan, Evermann and Clark, 1930: 110 (combined with *congestum*). De Buen, 1940: 11 (compiled). Alvarez, 1950: 42-43 (in part; Mexican range only).

Myzostoma congestum.—Meek, 1904 (xxxiv—Rio de los Conchos system in Tamaulipas; xxxi, 34—all but the El Paso record).

Moxostoma congestum albidum.—Knapp, 1953: 45 (compiled; said to intergrade with *congestum* in the Rio Grande Valley). Robins and Rarey, 1956: 8 (tentatively considered a subspecies of *congestum*).

Material examined.—The type series USNM 170 consists of two specimens (74 and 84 mm standard length), the largest of which is nearly broken in two. They were taken in Rio San Juan near Monterey, Nuevo Leon, Mexico (Rio Grande Drainage) by Lt. D. N. Couch in 1853. We designate the smaller specimen as lectotype. The other one is recataloged as USNM 164524.

UMMZ 97382 (3, 142-191) subtopotypes, trib. to Rio San Juan near

Montemorelos, Nuevo Leon, Mexico by Creaser, Gordon and Ostos, April 21, 1930. UMMZ 166717 (6, 54-109) Mexico, trib. of Rio Conchos $\frac{1}{4}$ mi. S. of Meoqui, Chihuahua, collected by Paul R. Needham and party on August 20, 1952. SNHM 47591 (1, 110) Rio San Pedro, Meoqui, Chihuahua, M. R. Brittan, August 9, 1952. USNM 55846 (2, 104-112), SNHM 9340 (2, 113-136), Rio Pilón in the Soto la Marina basin at Garza Valdez, Tamaulipas, Mexico, collected by Seth E. Meek. SNHM 47617 (1, 60) Durango, Rio Florido, near Canutillo, near Mexican hwy. 45, M. R. Brittan, August 10, 1952. SNHM 47609 (1) Durango, trib. to Rio Florido, 7 mi. N. Las Nieves, M. R. Brittan, August 10, 1952. UMMZ 161728 (1, 53) Durango, Rio Florido between El Cristo and Villa Ocampo, J. Greenbank and party, February 19, 1951.

Description.—The dorsal rays number 11 (see Table 1), a feature which appears consistent throughout the range. In the limited material available the plicae tend to break into papillae on the posterior half of the lower lip although this is not marked. The lower lip is full so that the two halves form a straight border posteriorly. The posterior-lateral border of the lips is squarish in sharp contrast to the condition found in *congestum*. No concentric folds of skin are noted around the corners of the mouth in our material. Proportional measurements are given in table 2.

Although *albidum* exists in Mexican tributaries of the Rio Grande and *congestum* is found in the Rio Grande and in some of its northern tributaries no clear pattern of intergradation is evident. Hubbs, Kuehne and Ball (1953: 22) say that their extensive series of *congestum* show no tendency toward *albidum*. Specimens collected in Pinto Creek of the Rio Grande system, UMMZ 120295 (see data above and Robins and Raney, 1956, pl. 3) and in the Rio Grande proper at El Paso, SNHM 844, closely resemble *albidum* in lip structure although they have the 12 dorsal rays of *congestum*. Conversely, two juveniles from the Pecos River near Roswell, New Mexico, UMMZ 66181, resemble *congestum* in lip structure but have 11 dorsal rays as in *albidum*. They are perhaps intergrades and certainly they come from an area where the occurrence of intergrades would be expected. Since the lower reaches of streams tributary to the Rio Grande and the Rio itself are apt to become dry in times of drought, populations in the contact area are possibly wiped out or decimated from time to time. This would serve to restrict gene flow between the two subspecies and possibly has prevented the formation of a broad zone of intergradation in the Rio Grande valley. Large series of specimens from the Rio Grande region must be available before a solution of this problem can be attempted.

Range.—In Mexican tributaries of the Rio Grande from the Rio Florido of Durango and the Rio Conchos of Chihuahua to the Rio Salado of Coahuila and the Rio San Juan of Nuevo Leon and southward in Gulf drainages to the Rio Soto la Marina in Tamaulipas. The species has not been recorded previously from Durango.

The status of Moxostoma parvidens Regan.—Regan (1907: 147,

TABLE 1.
FIN-RAY AND LATERAL-LINE SCALE COUNTS IN THREE SPECIES OF *Morostoma*

Species	Dorsal Rays			Anal Rays			Pelvic Rays			Pectoral Rays			Lateral-line Scales													
	10	11	12	13	6	7	8	8	9	10	11	15	16	17	18	19	41	42	43	44	45	46	47	48	49	
<i>congestum congestum</i>	—	8	53	—	—	22	—	4	65	5	—	11	61	22	1	—	—	2	16	18	12	5	—	—	—	
<i>congestum albidum</i>	—	18	—	1	—	14	—	1	17	—	—	1	7	9	3	—	—	1	3	1	2	2	4	2	—	
<i>austrinum austrinum</i> (Rio Grande de Santiago)	5	44	10	—	1	52	—	2	65	13	1	7	35	34	6	—	1	—	3	5	15	17	9	—	—	
<i>austrinum austrinum</i> (Rio Armeria)	—	19	1	—	—	20	—	—	37	2	—	—	15	23	—	—	—	—	6	5	5	2	1	1	—	
<i>austrinum milleri</i>	—	5	23*	—	—	4*	—	—	8*	—	—	—	9*	3	—	—	—	—	—	—	—	—	1	1	2	—
<i>mascofiae</i>	—	28	—	—	—	23	1	1	35	10	—	—	10	24	12	1	—	1	3	7	6	4	3	—	—	

* Holotype

table 24, fig. 3) described and figured a new species of *Moxostoma* which was allegedly taken from the Rio Grande at Juarez. DeBuen (1940: 11), Fowler (1945: 23) and Alvarez (1950: 42) based their accounts on Regan (1907). Clark Hubbs (1954: 278) identifies the type of *M. parvidens* with *M. erythrurum* on the presumption that the locality was in error. Although *erythrurum* and *congestum* belong to different subgenera and differ trenchantly in numerous features they have a similar body form. The description of Regan does not treat the diagnostic features although his listing of 14 dorsal rays (= 13) would not suggest *congestum* or *albidum*. Dr. N. B. Marshall of the British Museum of Natural History has kindly re-examined the two types of *parvidens* and notes that there are 12 (5-2-5) scales around the caudal peduncle, a feature of the subgenus *Moxostoma* to which *erythrurum* belongs. While the interradiial membranes of the dorsal and caudal rays are darkened (as in *erythrurum*) the conspicuous black slashes of *congestum* and its allies (*robustum*, *mascotae*, *austrium*) were not noted. Dr. Marshall further notes that Dr. Carl L. Hubbs had earlier examined the types and considered them specimens of *erythrurum*. We concur with this identification and note that the type locality is in error since *M. erythrurum* is not known south of the Red River drainage of Oklahoma; we have seen one specimen, USNM 77942 from Cache Creek in southwestern Oklahoma. As suggested by Hubbs (1954: 278) a mix up of localities must have occurred when these specimens were sent to the British Museum along with a collection from Kentucky, where *erythrurum* is common.

MOXOSTOMA AUSTRINUM (BEAN)

Description.—A fairly large species; the largest specimen at hand is 322 mm in standard length. The body is deep forward, being deepest at or slightly forward of the origin of the dorsal fin. The dorsal profile is convex in front of the dorsal-fin origin and concave behind but the shift in curvature is not so marked as that seen in *congestum*. The ventral profile is relatively flat in front of the anus although the belly is somewhat swollen. Behind the anus the ventral contour slopes upward to the caudal-fin base; the slope is steepest along the base of the anal fin. The body is compressed; its depth greatly exceeds its width.

In lateral view the head is subconical. The depth of the head at the occiput slightly exceeds its breadth. Seen from above the snout is bluntly V-shaped. The eye is situated forward of the midpoint of the head. In normal position the large mouth is included. The mouth and lips are long and the lower lip is especially broad. The two halves of the lower lip form a straight posterior margin or at most meet at a very obtuse angle. The upper lip is enlarged medially; the width of the lower lip at its midpoint equals the diameter of the eye and is nearly half the greatest distance across the mouth. The gape is generally a broad arc; it is not so U-shaped as in *mascotae*.

TABLE 2.
MEASUREMENTS OF ADULT *Moxostoma* IN THOUSANDTHS OF STANDARD LENGTH. THE RANGE OF VARIATION IS LISTED FOR EACH CHARACTER WITH THE MEAN BELOW (NO DIFFERENCES WERE NOTED BETWEEN THE SEXES).

Species	<i>austrinum</i>				<i>mascofae</i>				<i>congestum</i>			
	<i>austrinum</i>		<i>milleri</i>		<i>mascofae</i>		<i>albium</i>		<i>congestum</i>		<i>congestum</i>	
	Rio Lerma	Holotype	Paratypes	Durango	Rio Ameca	Rio San Juan	Rio Grande	Rio San Juan	Rio Grande	Rio San Juan	Rio Grande	Rio Grande
No. of specimens	10	1	5		14	3	4					
Standard length in mm	109-186	138	224-235		95-209	142-191	127-202					
Head length	225-268 250	244	232-268 246		233-278 250	234-261 247	248-259 252					
Snout to occiput	166-203	180	168-194		178-217	178-189	192-212					
Snout length	188		180		192	185	202					
Eye length	91-119	95	94-114		94-117	99-106	98-108					
Postorbital, least	105		104		105	102	104					
Head depth at eye	43-50	46	34-43		41-59	44-49	46-50					
Head depth at occiput	47		39		47	47	48					
Body depth	64-86	83	77-89		78-110	70-81	74-78					
Body width	77		83		88	76	75					
Gape width	136-154	141	143-155		125-155	146-158	151-163					
Caudal peduncle, least depth	147		150		136	153	156					
Dorsal fin, height	164-190	165	170-186		150-187	178-184	178-191					
Anal fin, height	181		178		165	182	184					
	232-264	228	221-241		196-243	244-270	250-296					
	238		230		214	256	270					
	134-165	149	153-178		122-149	175-200	155-172					
	154		166		135	186	164					
	57-83	64	59-61		60-81	50-74	53-62					
	69		59		70	64	59					
	94-108	89	85-96		83-112	99-109	105-111					
	101		91		94	104	108					
	175-205	184	164-180		180-234	198-204	178-210					
	198		172		199	202	193					
	213-227	216	178-249		214-258	212-243	205-234					
	218		212		230	224	218					

The subspecies *milleri* and *austrinum* differ slightly in the details of the mouth.

The mid-section of the occipital line is truncate and reaches far forward as in *mascotae*.

The origin of the dorsal fin is nearer the snout tip than the posterior edge of the hypural plate. The pectoral fin is relatively short and its depressed tip does not approach a vertical projection from the dorsal-fin origin. In this feature *austrinum* differs from *mascotae* and *congestum*. The origin of the pelvic fin is closer to the anal opening than to the insertion of the pectoral fin and lies directly under the anterior half of the dorsal fin.

The intestine is an elongate coil which is directed toward the right in the ventral part of the body cavity. As noted above, this feature differs from the large, tight, spiral-shaped coils of *mascotae*, but little is known of the variability of intestinal configuration in this and other catostomid fishes. The peritoneum is silvery. The pharyngeal arch is similar to that of *mascotae*. Its lateral shelf is much reduced (narrower than the height of the inner teeth which are longest), a feature which sets *mascotae* and *austrinum* apart from *congestum*. The teeth gradually diminish in length and thickness toward the tip of the arch. Each tooth possesses a small hook at its tip. The posterior fontanelle is rectangular and well developed as in other *Moxostoma*.

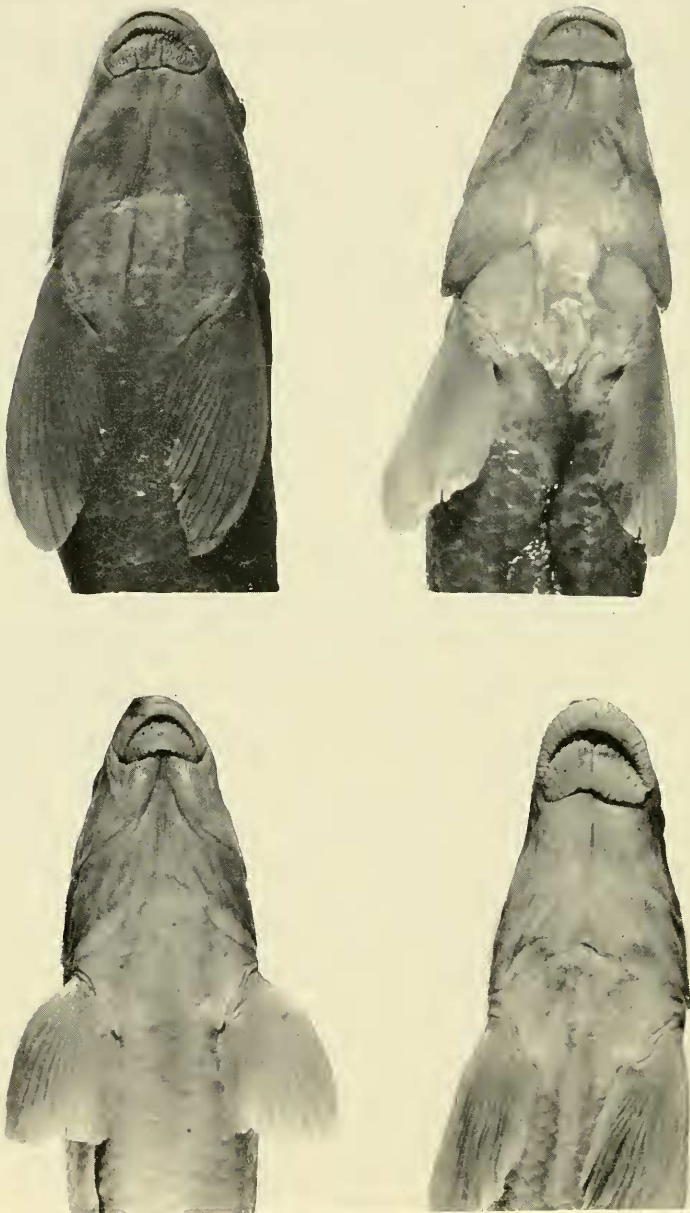
The tripus of *austrinum* has been described by Robins and Raney (1956: 35) and is similar to that of *mascotae*.

Fin-ray and lateral-line scale counts, and proportional measurements are given in tables 1 and 2.

Coloration.—The body is dark above; the dark extends ventrally almost to the paired fins. The lower surface of the body is light. Only along the lower portion of the caudal peduncle and on the lower third of the head is there a sharp division between the light ventral color and the dark dorsal color.

The scales of the dorsum and upper side are dusky throughout but the melanophores are concentrated along their edges. A dark wedge-shaped spot exists at the base of each scale. However, in contrast to *mascotae*, which also has dark scale bases, rows of spots are not a noticeable feature of the color pattern. Instead the entire side exhibits a dark diamond-shaped pattern. Generally, *M. a. austrinum* does not exhibit longitudinal streaking, since the lighter centers of the scales do not run together. *M. a. milleri* tends to be more streaked. The young and juveniles are not streaked and resemble *mascotae* in this respect. The mid-dorsal region of the young is darkest. An irregular blotch often is present before the dorsal-fin origin.

In adults the cheek and opercle are bicolored. The inner surface of the opercle is covered with melanophores. One feature of coloration which may distinguish *mascotae* and *austrinum* is the contrast in



Figures 5-8. 5. (top left) *Moxostoma congestum albidum*, ventral view of the same specimen illustrated in figure 1; 6. (top right) *Moxostoma austrinum milleri*, ventral view of the same specimen illustrated in figure 2; 7. (bottom left) *Moxostoma austrinum austrinum*, ventral view of the same specimen illustrated in figure 3; 8. (bottom right) *Moxostoma mascotae*, ventral view of the same specimen illustrated in figure 4.

color between the dorsal aspect of the head and nape. In *mascoetae* the head is just as dark as the nape while in *austrinum* the head is distinctly lighter than the nape in the specimens examined.

In *mascoetae* the medial portion of the dorsal-fin membrane is very dark, is less developed between the anterior rays and does not extend on the lighter distal third of the fin nor toward the basal quarter. When spread the fin shows a series of vertical dark slashes (the more posterior ones are darker. The caudal and anal fins are similar in pattern. This feature is typical of both sexes in *mascoetae* but is very weakly developed in females of *austrinum*, and is far less striking in the males of *austrinum*.

Sexual dimorphism.—Dimorphism in fin shape is similar to that of *mascoetae* which is described in detail below. The pattern of breeding tubercles is similar to that described below for *mascoetae* but they are much less developed. Our specimens of *austrinum* were collected in March, however, and are perhaps not comparable.

Distribution.—*M. austrinum* is distributed along the Pacific coast of Mexico from the Rio Mezquital (the upper portion of the Rio San Pedro), Durango, to the upper tributaries of the Rio Armeria, Jalisco.

SUBSPECIES OF MOXOSTOMA AUSTRINUM

The population of *austrinum* in the Rio Mezquital differs in many features from those in the Rio Grande de Santiago (including the Rio Lerma) and in the Rio Armeria. Considering the constancy of meristic and other features in this genus the differences noted in the Rio Mezquital population are believed worthy of subspecific recognition. We take great pleasure in naming this subspecies after Dr. Robert R. Miller who has contributed much to our knowledge of Middle American ichthyology.

MOXOSTOMA AUSTRINUM MILLERI new subsp.

—*Moxostoma austrinum*.—Meek, 1904: xxxvii, 35 (in part, headwaters of the Rio Mezquital).

Moxostoma austrinum.—Regan, 1907: 146 (in part, Durango locality only), De Buen, 1940: 11 (in part, upper reaches of the Rio Mezquital), Robins and Raney, 1956: 9 (relationships).

Material examined.—All 59 specimens examined were taken in the Rio Mezquital basin in the vicinity of Victoria de Durango (Durango City), Durango, Mexico. The holotype, USNM 132446, female, 138 mm. in standard length, was taken at Rayar, about 5 mi. S. of Durango City on May 10, 1946 by Ralph G. Miller.

Taken with the holotype was a paratype, USNM 169889, 29 mm. S.L. Additional paratypes are UMMZ 173136 (2, 224-232). They are part of a collection taken May 5, 1939 from three localities near Durango City by C. L. Turner. The remainder of this series, UMMZ 173136 (53, 21-39) are very small specimens which are identified with this subspecies but are not designated paratypes. Additional material examined: UMMZ 161693 (2, 224-235), Rio Mezquital (or trib.), approximately 3 mi. S. of Durango City, Mexico, February 16, 1951, John T. Greenbank.

Diagnosis.—Dorsal rays usually 12, rarely 11. Lower lip full and plicate; the plicae are narrow, numerous (about 25) and tend to break up posteriorly. Some approach a semi-papillose condition. Pectoral and anal fins pointed (the pectoral fin has rays 3 and 4 longest rather than 4 and 5 as do other *Scartomyzon*). The distance from the midpoint of hypural to the pelvic-fin base when measured forward rarely reaches the posterior margin of the lower lip. Scales large; the dorsolateral scales from beneath the origin of the dorsal fin are as large in area as the eye.

The body features are illustrated in figures 2, 6 and 10. The fin-ray and scale counts and proportional measurements are given in tables 1 and 2.

Range.—Known only from the upper reaches of the Rio Mezquital in Durango, Mexico.

MOXOSTOMA AUSTRINUM AUSTRINUM (BEAN)

Myxostoma austrina.—Bean, 1880: 302-303 (description, type locality: Piedad in Morelia, = Michoacan).

Myxotrema austrinum.—Jordan and Gilbert, 1883: 125 (compiled, based on Bean, 1880).

Moxostoma austrinum.—Woolman, 1894: 61 (Rio Lerma at Salamanca). Jordan and Evermann, 1896a: 192; 1896b: 242 (basin of the Rio Lerma - Rio de Santiago). Jordan and Snyder, 1900: 120 (Rio Verde, Aguascalientes and Rio Grande de Santiago near Atequiza; meristic data). Meek, 1902: 76 (La Palma Ocotlan and Lago de Chalco, all in the basin of the Rio Lerma). Regan, 1907: 146 (compiled; Aguascalientes and Atequiza (sic) in Jalisco; Salamanca in Guanajuato; Lake Chapala, Morelia in Michoacan). Fowler, 1913: 57 (compiled). Jordan, Evermann and Clark, 1930: 110 (compiled). De Buen, 1940: 11 (in part, compiled; excluding Rio Mezquital).

Moxostoma austrina.—Eigenmann, 1893: 55 (Guanajuato).

Myxostoma austrinum.—Meek, 1904: xl, 35 (basin of the Rio Lerma).

Material examined.—Rio Lerma - Rio Grande de Santiago: USNM 23120 (1, 314) cotype of *M. austrina* Bean, collected at Piedad in Morelia (Michoacan) by A. Dugès. Hereby designated as lectotype. USNM 23121 (1, 322) a cotype, taken with the type. USNM 37821 (1, 209) collected later by A. Dugès apparently near the type locality. UMMZ 172231 (171, 12-184) Barranca de Barranquitos at Barranquitos, 74 mi. S.E. of Tepic, in Jalisco (el. 3200 ft.), R. R. Miller and J. T. Greenbank, March 26, 1955. SNHM 1028 (1, 64) Salamanca, A. J. Woolman. SNHM 6192 (10, 96-144) Aguascalientes, Rio Verde, J. O. Snyder.

Rio Armeria: UMMZ 172206 (1 ad, 175; 29 yg, 14-59) trib. of Rio San Pedro at bridge 9 mi. N. E. of Autlán, Jalisco (el. 3200 ft.), R. R. Miller and J. T. Greenbank.

Comparative diagnosis.—Only those features in which subspecies *milleri* and *austrinum* differ need be discussed here. The dorsal rays are usually 11, rarely 12 (see table 1). The plicae of lower lip are broader and less numerous (usually less than 20) and are entire. The pectoral and anal fins are more rounded in *austrinum* (rays 4 and 5 rather than 3 and 4 are longest) than in *milleri*. The distance from the posterior edge of the hypural to pelvic base when measured for-

ward reaches the upper lip. The scales of *austrinum* are relatively smaller than those of *milleri* although this is not evidenced by scale counts. However scales taken from above the lateral line and below the dorsal-fin origin are decidedly smaller in area than the eye. Fin-ray counts and proportional measurements are given in tables 1 and 2. Dorsal and anal-ray counts listed by Jordan and Snyder (1900: 120) are added to our data in table 1. Their counts of lateral-line scales are somewhat higher than in specimens of *austrinum* examined by us; perhaps this reflects a difference in counting technique. These data (not added to our table) with the number of specimens in parentheses are: 45 (1), 46 (3), 47 (4), and 48 (4).

Distribution and habitat.—Widely distributed in the Rio Grande de Santiago above three thousand feet and in its upstream portion, the Rio Lerma. It has been recorded from the States of Jalisco, Aguascalientes, Guanajuato and Michoacan. Southward across the mountains it is herein recorded for the first time from the Rio Armeria which enters the Pacific Ocean in Colima. This system apparently marks the southernmost penetration of the genus.

Jordan and Snyder (1900: 115) describe the Rio Verde de Aguascalientes where specimens of *M. a. austrinum* were collected as follows: "The clear, cool water, shaded by trees and shrubs along the banks, winds here and there over a bed of fine gravel and sand. There are ripples and shallows, . . . , and many deep pools . . ."

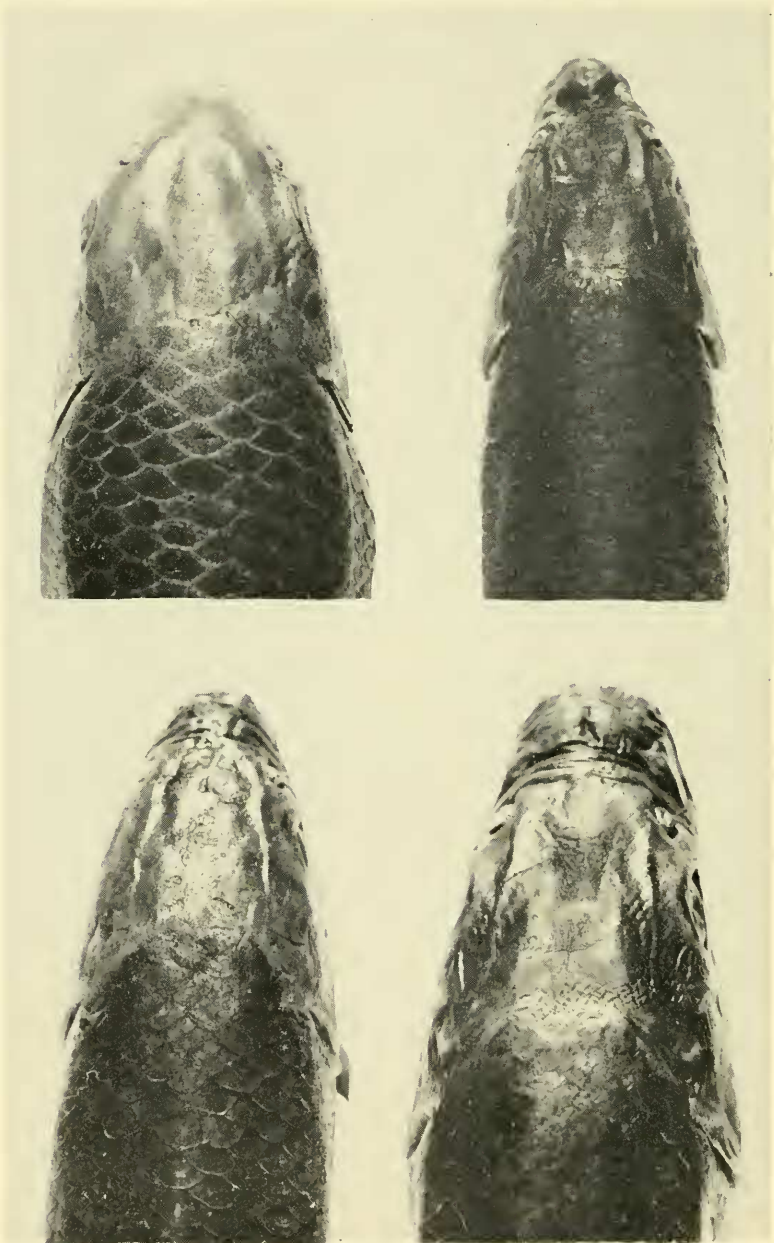
MOXOSTOMA MASCOTAE REGAN

Moxostoma mascotae.—Regan, 1907: 145, 147, table 24, fig. 2 (original description, type locality: near the source of the Rio Mascota at a height of 4000 feet). Jordan and Evermann and Clark, 1930: 110 (compiled). Alvarez, 1950: 43 (translation from Regan). De Buen, 1940: 11 (compiled).

Material examined.—All collected by Robert R. Miller and John T. Greenbank. Mexico: UMMZ 172234 (19, 13-30) trib. Rio Ameca, about 1 mi. S.W. of Tetitlán, Nayarit (el. 2700 ft.), March 27, 1955; UMMZ 172125 (34, 19-210) Rio Ameca, 25 mi. by Hwy. 70 E. of Ameca Jalisco (el. 4300 ft.), February 27, 1955.

Diagnosis.—An elongate species with a flat ventral surface, subquadrate head, and large lips which are swollen and strongly plicate. Snout long and truncate. Pectoral fins elongate, apparently adapted for fast water and in this regard parallels species of *Hypentelium*. Fin membranes very dark. Dark wedge-shaped spots line the body and are especially noticeable on the first two rows of scales below the lateral line. Here the pattern is similar to that of *Minytrema melanops*. Dorsal rays number 11, a feature shared by *M. a. austrinum*, but distinct from the 12-rayed condition in *M. a. milleri*. Midline of dorsum midway between occiput and dorsal-fin origin with hard keel (formed by the anterior interneurals).

Description.—Apparently a small species, the largest seen by us is 210 mm in standard length. The body is decidedly elongate and compressed. Like related species the body is deep forward. The dor-



Figures 9-12. 9. (top left) *Moxostoma congestum albidum*, dorsal view of the same specimen illustrated in figure 3; 12. (bottom right) *Moxostoma mascotae*, dorsal view of the same specimen illustrated in figure 2; 11. (bottom left) *Moxostoma austrinum*, dorsal view of the same specimen illustrated in figure 1; 10. (top right) *Moxostoma austrinum milleri*, dorsal view of the same specimen illustrated in figure 4.

sal contour is strongly convex from the dorsal-fin origin to the eye. Due to the strong development of the snout large specimens tend to have the dorsal profile somewhat concave above the snout. The body narrows markedly dorso-ventrally under the dorsal fin. Between the dorsal fin base and the posterior end of the caudal peduncle the dorsal profile is straight or only slightly concave. The preanal ventral profile and the lower edge of the caudal peduncle is flat. The body deepens markedly under the anal-fin base.

The body is noticeably compressed; its depth at the origin of the dorsal fin greatly exceeds the greatest body width.

The head is subquadrate in lateral view. The head depth at occiput slightly exceeds the head width. The snout is bluntly V-shaped from above. The center of the eye is slightly in advance of the mid point of the head and is situated high on the side of the head. In lateral view the snout is truncate anteriorly.

The mouth is huge and occupies the full width of the lower surface of the head anteriorly. Both lips are strongly plicate. The plicae of the lower lip branch somewhat posteriorly. Juvenile specimens have well defined plicae whereas the largest specimens have the furrows less clear, the plicae more broken. In no sense however, does this mouth approach a papillose condition. The gape is almost semi-circular; the upper lip curves far caudad laterally. The lower lip is broadly expanded but its posterior border is incised medially; the two lobes form a straight line or a very obtuse angle. In juveniles the lower lips are full. The posterior margin of the lower lip reaches a point directly under the anterior nostril. The upper lip is thickened medially.

The occipital line is located far forward and reaches to a point over the posterior edge of the cheek; its mid section is truncate. A dark occipital line continues downward on the shoulder. Ventrally it is wider and more conspicuous. It continues on the upper surface of the pectoral fin where it contrasts with the unpigmented first ray. The pigment is most intense behind the first ray and then fades slowly on the more posterior portions of the fin.

The position of the dorsal fin is subject to more variation than one generally associates with this feature. Its origin is most often slightly in front of the point midway between the snout and tip of hypural; in a few it is midway. It lies directly over the tip of the depressed pectoral and well in advance of the pelvic base. The pelvic origin is in advance of the middle of dorsal-fin base. The peritoneum is dark, becoming light posteriorly.

The dark intestine is curved on the right anteriorly. The pharyngeal arch is scythe-shaped with the lateral shelf almost lacking. Regan (1907) certainly was dealing with an incomplete or defective arch since there are easily more than 50 teeth per arch rather than 6 as he states. The inner teeth are best developed (the third tooth is largest in our example) and then the teeth gradually become shorter

and thinner so that it is difficult to estimate the number near the tip of the arch. All teeth are strongly compressed and slightly hooked. The fontanelle is rectangular.

The tripus of a specimen of *mascoetae* from the Rio Ameca, 25 mi. E. of Ameca was studied. This structure agrees with the description given by Robins and Raney (1956: 35) for *M. austrinum*. The inner margin of the shelf is high and convex.

Fin-ray and lateral-line scale counts, and proportional measurements are given in tables 1 and 2.

Coloration.—The dark of the dorsum extends to the first scale row below the lateral line and below gradually blends into the light belly. Each scale in the darkened portion of the body has a definite dark spot at the base. This is especially prominent in the adults. In smaller specimens the general dark color obscures the spots which are present. In half grown and young fish the scales are clear margined apically with a dark subterminal bar. This is less striking in the larger specimens. The coloration of the young (35 mm and less) is worthy of note. Robins and Raney (1956) have described the striking pattern of stripes which characterize young of the related *M. robustum*. In *mascoetae* no streaks are present on the young except for a trace of dark pigment along the mid dorsum. Faint dark blotches are present at the origin of the dorsal fin, just behind the dorsal fin, and on top of the caudal peduncle; a pattern shared by many members of the genus. Juvenile specimens rarely show a faint suggestion of such blotching.

Horizontal streaks which are present even in the adults of *M. robustum* and *M. congestum* are not seen in *austrinum*. The prominent basal scale spot and subterminal vertical dark marks on the scales break up such a pattern and present a general dusky picture with the central regions of the scales being lighter.

The cheek is bicolored; dark pigment extends to below the lower margin of the orbit. The head is dark dorsally. The opercle and snout are generally dusky. The light of the lower cheek extends on to the more ventral aspect of the snout.

Sexual dimorphism.—Fins: In the male the pelvic fin is longer; its length when projected caudad from the pelvic tip, reaches the posterior end of the anal base or nearly so. In the female it falls near the anterior portion of the anal fin base. In the female the posterior edge of the pelvic fin when spread is truncate, the inner corner a rounded right angle. In its natural position the fin is rounded with the medial rays clearly the shortest. In the male the posterior edge of the fin when spread is oblique; the inner corner forms a rounded acute angle. In its natural position the fin appears pointed.

The pectoral fin is somewhat longer in the male than in the female. The male has a larger and more expanded anal fin; its tip is broadly rounded and in mature individuals reaches well beyond the end of

vertebral column. In the female it falls short of this point and has an acute tip.

The dorsal fin shows marked sexual dimorphism. In development, this feature seems to be the first to exhibit sexual dimorphism clearly. The edge in the male is sigmoid, the posterior lobe broadly expanded and rounded. When fully spread the margin is almost straight. In the female the posterior lobe is straight edged and the anterior lobe more projecting so that the fin edge is clearly falcate.

Breeding tubercles: Observations were made on specimens taken in February; the tubercles are probably more pronounced at the height of the breeding season. Males of 100 mm have breeding tubercles well developed. Only the larger females have tubercles and these are small. In males the distal fourth of the anal fin is free of the tubercles in most instances, but they appear on each ray and become smaller toward the base of the rays. Some males have tubercles on tip of the anal rays but here the largest are almost one-fourth the way in from the tip. Ten or more tubercles may be present on the longer rays. In males, tubercles are present also on the caudal fin and are here best developed on the lower half of the fin. Scales on the ventral surface and lower sides of caudal peduncle bear tubercles. These may occur anywhere on the scale, and are not restricted to or even numerous on the edges. Small tubercles are scattered over the upper surface of rays of the pectoral and pelvic fins of the male. Minute scattered tubercles cover the entire upper half of head and snout. The dorsal fin, ventral surfaces of paired fins and body (except as noted) are free of tubercles in the male.

Large females have tubercles arranged on the anal fin as in males but they are much less developed. Smaller tubercles are scattered on the rays of the lower half of caudal fin and careful search may reveal a few on the upper surface of the paired fins. The body behind the anus including the entire caudal peduncle is tuberculate. These tubercles are neither pointed nor well defined but are very numerous, and cause a thickening of the entire surface of the scales on the lower half of caudal peduncle. There are far fewer tubercles on the dorsal half of the caudal peduncle and on the forward area above the anal fin. The head is not tuberculate.

Distribution.—*M. mascotae* is apparently restricted to the Rio Ameca and its tributary, the Rio Mascota, in Jalisco on the Pacific Slope of Mexico.

DISPERSAL AND RELATIONSHIPS OF THE MEXICAN SUCKERS OF THE GENUS *Moxostoma*

As we noted earlier (Robins and Raney, 1956: 37), the *robustum* species group is probably the most primitive in the subgenus *Scartomyzon*. The present distribution of this group presents a picture of geographically distant, remnant populations of a once continuous distribution.

Although one is tempted to explain this distribution by convergent evolution so many fundamental characters are shared by *robustum*, *congestum*, *austrinum* and *mascoetae* that we feel confident the group is a natural one. Differentiation has been very slow as evidenced by the remarkable constancy of features from widely scattered localities.

M. mascoetae and the two subspecies of *austrinum* differ as a unit from *congestum* and its subspecies in several features which we feel are indicative of a common ancestry. They seem to represent a single, old invasion of the Pacific slope by an ancestral *congestum* or *congestum-austrinum* stock. Such an opportunity may well have presented itself in some former pluvial period, although certainly not a recent one (*i.e.*, not in terms of Wisconsin glaciation). The Lerma-Santiago valley probably has served as the center for dispersal on the Pacific slope. The invasion of the Ameca basin by cross mountain capture occurred early since *mascoetae* and *austrinum* are quite distinct. *M. mascoetae* is apparently adapted for life in fast mountain rivers. It occurs at high elevations. Miller notes (*in litt.*) that the Ameca has a very interesting fish fauna with a high percentage of endemics on the plateau portion. In contrast, *austrinum* has apparently entered the Rio Armeria basin much more recently from the Rio Lerma by headland streams capture. The two populations have not differentiated.

The origin of *milleri* in the Mezquital basin is perplexing. Although we choose to retain it as a subspecies of *austrinum* it is well differentiated and the stock may be just as early in its origin from Rio Grande de Santiago stock as *mascoetae*. The similarity to *austrinum* and *mascoetae* in certain features of its anatomy we feel preclude an independent origin of *milleri* from *congestum* stock. Miller notes (*in litt.*) that although the lower portion of the Rio Mezquital (the Rio San Pedro) closely approaches that of the lower Rio Grande de Santiago, the fauna of the Lerma and the Rio Mezquital is wholly different in the Plateau and Coastal Plain portions of these drainages. For example, none of the 10 species (2 suckers, 3 minnows, 1 catfish, 1 cyprinodontid, 1 goodeid, 1 darter, and 1 atherinid) known from the Mezquital occurs on the coastal plain and similarly the fauna of the Lerma is very distinct from that of the lower part of the Rio Grande de Santiago. These faunal differences were also noted by Meek (1904, map opposite p. xlvii).

The barrier to downstream dispersal between these two systems is thus ecological as well as physical. The entrance of *austrinum* stock into the Mezquital must have been by a more upland capture and its subsequent isolation in the Mezquital has been of long duration.

The distribution of the forms of *congestum* does not pose any serious problems. The geographical relationships of these forms are treated above.

SUMMARY

The distribution, variation and relationships of *Moxostoma congestum*, *M. austrinum* and *M. mascoetae* are treated. *M. albidum* is

considered a subspecies of *congestum* and a new subspecies, *M. austrinum milleri* is diagnosed. With *M. robustum*, these species form a natural group within the subgenus *Scartomyzon*.

Morphological study suggests that the species of the Pacific slope of Mexico, *austrinum* (2 subspecies) and *mascoetae*, are closer in their relationship than either one is to *congestum* of the drainage of the Gulf of Mexico. A common origin seems likely. The difference between the three forms found in the Pacific drainages reflect their long period of isolation since differentiation appears to progress slowly in this genus.

The southern limit of the known range of the genus *Moxostoma* is extended southward on the Pacific slope of Mexico to include the headwaters of the Armeria basin in Jalisco.

Moxostoma parvidens Regan is referred to the synonymy of *M. erythrum*.

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ABSTRACT

Three species of *Moxostoma*, *congestum*, *austrinum* and *mascoetae*, occur in Texas, New Mexico and Mexico. They are described in detail, their morphological variation noted and their distribution and relationships discussed. All belong to

the subgenus *Scartomyzon* of which *robustum* of southeastern United States is most closely related.

A new subspecies of *austrinum* is diagnosed and *M. albidum* is considered a subspecies of *congestum*.

M. austrinum and *M. mascotae* are the only members of the speciose genus, wide ranging in eastern North America, that occur on the Pacific Slope of North America. They are closely related and apparently resulted from a single transfer of fishes from Atlantic to the Pacific Slope during a past pluvial period.